

MEMORANDUM

TO: Tom Gruber
FROM: Dan Lennington and Trevor Hammons
DATE: February 9, 2009
RE: Country Cottage Groundwater Investigation

*Environmental
Protection Unit*

Introduction

The purpose of this memorandum is to provide an update concerning the EPU's investigation of a possible link between the land application of poultry waste and the August 2008 *E. coli* outbreak at the Country Cottage in Locust Grove, Oklahoma.

Background

The Country Cottage is a buffet-style restaurant in Mayes County, Oklahoma, just north of the town of Locust Grove. On August 22, 2008, the Oklahoma State Department of Health (OSDH) learned of a possible *E. coli* outbreak among the restaurant's patrons. The outbreak continued for many weeks and ultimately resulted in 314 known cases, 72 in-patient hospitalizations, and one death. OSDH has never identified a source of the outbreak, other than stating that *E. coli* was the cause of the illnesses, and that the victims came into contact with *E. coli* while eating at the restaurant.

During its investigation, OSDH did not find *E. coli* anywhere in the restaurant. OSDH and the Department of Environmental Quality (DEQ) did, however, find *E. coli* in the restaurant's well. During a loss of pressure in the city water supply, the restaurant used groundwater from the well in food preparation during the weekend of August 10th. Restaurant patrons with confirmed and suspected cases of *E. coli* dined at the restaurant shortly after the well was put in use.

Starting in September 2008, EPU initiated an investigation to discover whether bacteria from poultry waste could have contaminated the well. The investigation included the collection of groundwater samples from the Country Cottage and other nearby wells, a review of poultry records and aerial photos, several site visits, interviews with witnesses and government officials, and consultations with the State's expert witnesses from the Oklahoma Poultry Litigation.

Factual Findings

EPU concluded its investigation in January 2009. EPU learned the following facts:

1. The location of the Country Cottage well is within a mantled karst terrain, which provides the easy transport of surface contaminants to groundwater, and easy transport of contaminants within the groundwater itself.
2. Within a six mile radius of the Country Cottage well there are 49 active poultry houses that have the capacity to produce 12,000,000 birds a year and 10,000 tons of waste.
3. There is insufficient pasture land to properly dispose of 10,000 tons of waste annually in the vicinity of the poultry houses.
4. Poultry waste from these houses is typically land applied near the houses, including on many pastures within a few miles of the Country Cottage well.
5. Documents show that poultry waste may have been land applied as close as ¼ mile from the Country Cottage well.
6. A pathway exists connecting the poultry-waste-applied pastures to the Country Cottage well via the groundwater and mantled karst terrain.
7. The specific strain causing the outbreak, *E. coli* O111, has been found in poultry waste.
8. The Country Cottage well contained *E. coli* bacteria in August, September, October, and November 2008.
9. Samples taken from the Country Cottage well contain the poultry-specific *brevibacterium* (the "biomarker" identified through the PCR method).
10. Samples taken from the Country Cottage well contain a "strong" poultry signature (PCA method).
11. Wells in the immediate vicinity (within one mile) of the Country Cottage contain *E. coli*, poultry signature, and the poultry biomarker.
12. Septic systems and sewer lines in the area have been tested and are not the source of any human waste contribution to the groundwater in the vicinity of the Country Cottage well.
13. The Country Cottage Restaurant used well water in preparation of food on and around August 9th, 10th, and possibly later.
14. People who became ill dined at restaurant around August 10. The first laboratory-confirmed exposure was August 15, but according to OSDH, there were "probable" exposures between August 10th and August 15th.

Conclusions

Based on these factual findings, our experts have concluded that the Country Cottage well is, and has been, contaminated with poultry waste and associated bacteria, including *E. coli*. Because this well was used in food preparation around the time of the outbreak, it is possible that the well and its poultry-waste-contaminated groundwater was a source of the outbreak.

Meetings with State Agencies

After developing these conclusions and opinions with the State's expert witnesses, EPU began a process of communicating these conclusions to agencies,

including DEQ, OSDH, and the Oklahoma Department of Agriculture, Food & Forestry (ODAFF). Below is a short summary of the meetings with these agencies.

1. Oklahoma Department of Environmental Quality

Date: January 20, 2009

Location: DEQ, Oklahoma City

Attendees for DEQ: Martha Penisten (Acting General Counsel), Jon Craig (Director, WQD), Gary Collins (Director, ECLS), Richard McDaniel (Manager, ECLS), Rocky Amonette (Lab), Chris Armstrong (Lab), Sara Gibson (Legal), Gary Burnett (ECLS), Rick Austin (local Mayes County DEQ employee), Mark Hildebrand (WQD), Patrick Rosch (WQD)

Attendees for OAG: Dan Lennington, Trevor Hammons

Summary: On January 20, 2009, we met with representatives from DEQ, including their legal counsel and management-level employees from the Water Quality Division (WQD), Environmental Complaints and Local Services (ECLS), and the DEQ Laboratory. We explained our findings and conclusions. DEQ representatives were very interested in our findings and asked questions. We were able to answer all of their questions. They agreed that the Country Cottage well was contaminated with *E. coli* and the source of the *E. coli* was likely not a human source, because DEQ had tested the integrity of nearby sewer lines and septic systems. DEQ also expressed regret that OSDH had made public statements indicating that the well was not – and could not – be a potential source of the outbreak. DEQ agreed that the well could have been a source of the *E. coli* that caused the outbreak.

The only reservations expressed by DEQ were whether they had jurisdiction to address the problem. We explained to them that they have jurisdiction over public and private water supplies, which have been affected by the land application of poultry waste. Also, DEQ has general jurisdiction over pollution under 27A O.S. § 2-6-105. We then informed DEQ that we were meeting with the other agencies and would be getting back to them. DEQ volunteered to go with us to the meeting with OSDH. Overall, it was a very good meeting and our findings were considered seriously.

2. Oklahoma State Department of Health

Date: January 21, 2009

Location: OSDH, Oklahoma City

Attendees for OSDH: Dr. Michael Crutcher (Commissioner); Dr. Kristy Bradley (State Epidemiologist); Nick Slaymaker (General Counsel); Blake Bostic (Assistant

General Counsel); Rocky McElvany (Chief Operating Officer); Lisa Bennett-Webb (Public Information Officer); Teressa Madden (Epidemiologist)

Attendees for DEQ: Jimmy Givens (Acting Deputy Director); Richard McDaniel (Manager – ECLS)

Attendees for OAG: Dan Lennington, Trevor Hammons

On January 21, 2008, we met with representatives of OSDH. DEQ representatives also attended. We gave a detailed overview of our investigation. We explained our sampling and analytical results, including how our experts had ruled out humans and cattle as a source of the *E. coli* in the well, and that our experts had found poultry DNA and poultry signature in the well. We asked Dr. Kristy Bradley if the well is still considered a potential source of *E. coli*. She responded, “absolutely.” She then explained that although the first “laboratory-confirmed case” of *E. coli* exposure at the restaurant was August 15, 2008, OSDH believes that there were “probable” or “suspect” exposures to *E. coli* at the restaurant around August 9 and 10, when the well was first used in food preparation.

We had a very positive back-and-forth dialogue with OSDH regarding Country Cottage. Dr. Bradley confirmed that they had not identified the source of the contamination and had in fact looked at animal sources. Dr. Bradley expressed some reservations that poultry could be a source of *E. coli* O111 because the published literature suggests that this particular strain is more typically associated with cattle. We then shared with her two articles where researchers found *E. coli* O111 in poultry. We later emailed her several more articles showing a strong association between poultry waste and virulent strains of bacteria.

Dr. Bradley indicated that OSDH would be issuing a report concluding that they could not identify the precise source of the *E. coli* (other than the outbreak victims all ate food from the Country Cottage). She indicated that OSDH would be very interested in doing a study looking at feces from animals in the area (including cows and chickens) that might help determine the source of the outbreak. The only limitation on such a study is funding.

Overall, it was a very positive meeting with OSDH. They were very respectful and receptive to our investigation. They expressed a willingness to continue to look at the evidence that our investigation had uncovered. We promised to get them some information and informed them that we were meeting with ODAFF in the coming days.

After the meeting, we had a follow-up phone call with Dr. Bradley. Dr. Bradley again confirmed that the well was a possible source of the *E. coli* that caused the outbreak. She also said that she believes that it is “much more likely” that animals are the source of the *E. coli*, rather than humans.

3. Oklahoma Department of Agriculture, Food and Forestry

Date: February 3, 2009

Location: ODAFF, Oklahoma City

Attendees for ODAFF: Terry Peach (Commssioner); Larry Harden (General Counsel); Dan Parish (Director – Env. Management); Dr. Talkington (Lab Director, Veterinarian); Dr. Shirazi (contract hydrologist)

Attendees for OAG: Dan Lennington, Trevor Hammons

On February 3, 2009, we met with ODAFF to discuss our investigation of the Country Cottage *E. coli* outbreak. We explained why and how OAG was looking at the Country Cottage issue. We gave a detailed overview of all actions taken by this office over the last few months regarding the Country Cottage. We explained our sampling and analytical results, including how our experts had ruled out humans and cattle as a potential source of the well contamination, and that we had found poultry DNA and poultry signature in the well.

From the beginning of the meeting, we received numerous questions and comments that indicated that ODAFF was extremely skeptical of our investigation. Below, we have outlined each individual's expressed concern and comments. The comments are not necessarily in the order of the conversation.

Commissioner Peach said that had been "burned" by OAG in the past. Specifically, he stated that he "reluctantly" agreed to the sensitive watershed litter-hauling restrictions based upon our PCA and PCR science, which has now been "thrown out of court." He indicated that said he did not want to be burned again by OAG. He also said that OSDH had information suggesting that the *E. coli* outbreak was linked to a "Honduran" restaurant employee. This worker had recently returned from Honduras and is a suspected source of the contamination, according to Commissioner Peach. Commissioner Peach stated that OSDH had this information in their possession. Finally, Commissioner Peach expressed skepticism that OAG could ever prove that the poultry waste in the Country Cottage well came from a large-scale commercial poultry operation. He gave an example that the waste could have come from "an old lady spreading poultry litter on her garden."

Dr. Shirazi is ODAFF's part-time contract hydrologist. Larry Harden stated several times that Commissioner Peach would not take any administrative action unless Dr. Shirazi and Dr. Talkington both agreed that the action was based on good science. Dr. Shirazi said that we had no case based on the evidence presented. He said that the only way to prove that poultry waste contaminated the Country Cottage well was to (1) identify exactly where the poultry waste was land applied in the summer of 2008, (2) conduct field work to prove that poultry waste could infiltrate the surface and contaminate the groundwater below the pasture in that precise location, and (3) drill

several bore holes between the pasture and the well to prove that contaminants from the field could be transported to the Country Cottage well. Without this proof based on this field work, Dr. Shirazi said he would never believe that poultry waste contaminated the Country Cottage well.

Dr. Talkington expressed skepticism that the *E. coli* contamination could come from animal waste at all. He believed that this contamination came from human sources. He had no evidence to back up his claim, other than his belief that the majority of food-borne illnesses stem from human sources. He also expressed skepticism about Dr. Bradley at OSDH. We informed him that OSDH had told us that they were looking at possible animal sources, and in fact Dr. Bradley stated that the source of the *E. coli* was likely animal waste. Dr. Talkington scoffed at this suggestion.

Ag Foundation

In summary, in contrast to the other agencies' responses to our presentation, ODAFF's criticism was not constructive. ODAFF did not take our evidence seriously and made comments to us that can only be described as dismissive and disrespectful.

Further Action

At this point, it is necessary to determine whether the agencies will take any action at all. The land application season is fast approaching and bacteria-laden poultry waste will again be spread on the pastures surrounding Locust Grove. These land-application events pose a threat to the health and safety to those who drink untreated groundwater.

We believe the agencies have the authority and cause to take the following administrative actions:

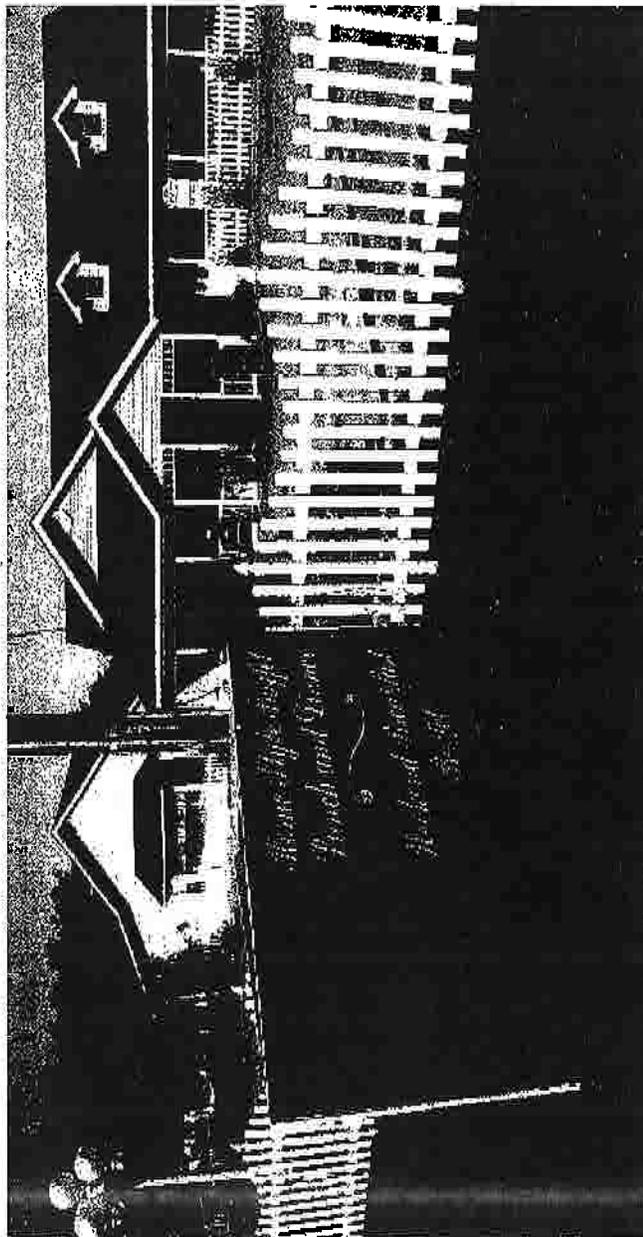
1. An immediate ban on the land application of poultry waste in southern Mayes County.
2. An investigation of potential sources of *E. coli* O111 in and around Locust Grove lead by OSDH, with coordination by ODAFF to provide access to poultry facilities.
3. A survey of groundwater quality in and around Locust Grove lead by DEQ.
4. A public information campaign to inform those who use private drinking water wells in eastern Oklahoma about the risk of contamination posed by local agricultural practices.

Dept of Ag - no

If the agencies will not take action, then we would recommend opening a dialog directly with the United States Environmental Protection Agency and the Centers for Disease Control. We would also recommend considering whether it may be appropriate for OAG to request a state or federal court to issue an injunction prohibiting the future land application of poultry waste in and around Locust Grove without treatment or composting.

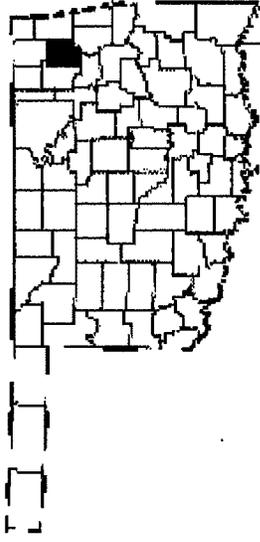
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Poultry waste as a possible source of August 2008 *E. coli* outbreak

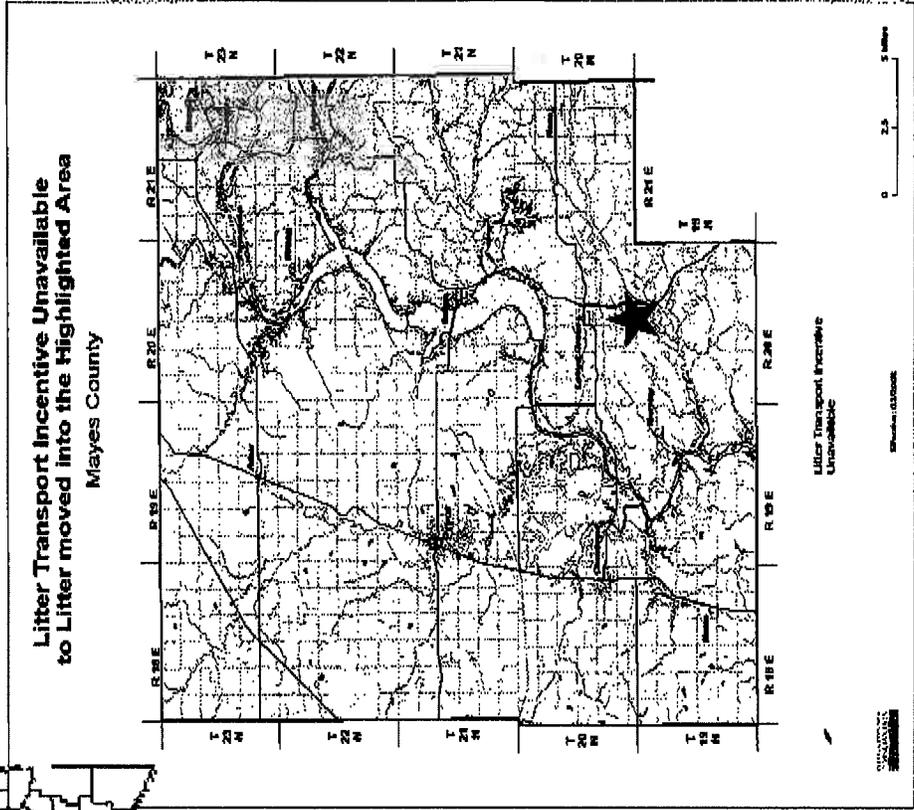


Country Cottage
Restaurant
Locust Grove,
Oklahoma

Country Cottage Restaurant, Locust Grove



- Mayes County
- Fort Gibson Watershed
- Just south of Lake Hudson
- 45 miles due east of Tulsa



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Timeline of Outbreak

- **Aug. 9-10**
 - Loss of pressure in Locust Grove water supply.
 - Country Cottage switches to well water.
 - Country Cottage reports that it used the well for at least two hours a day for each of the two days.
- **Aug. 10-24**
 - Before Aug. 15 - "Probable" or "Suspect" exposures to *E. coli* at Country Cottage Restaurant.
 - Aug. 15-24 "laboratory confirmed" exposures to *E. coli* at the restaurant.

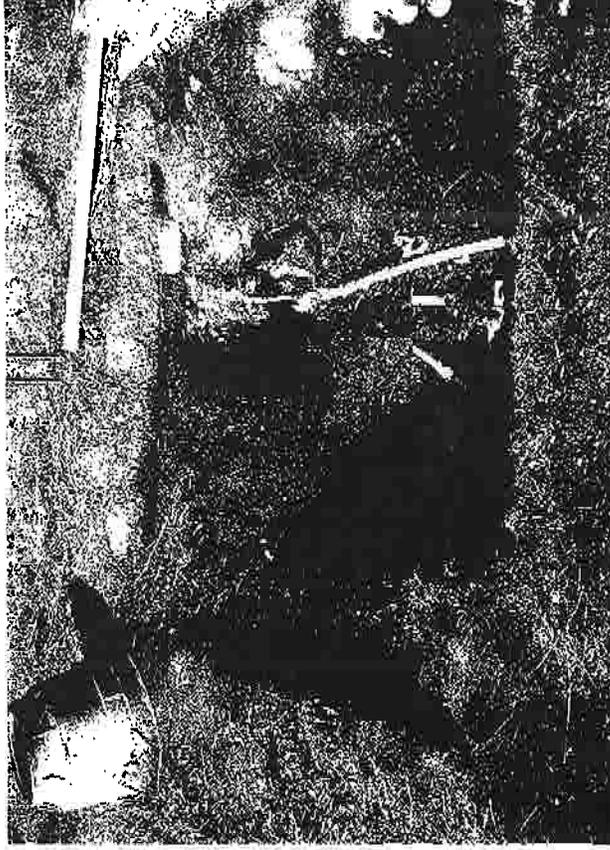
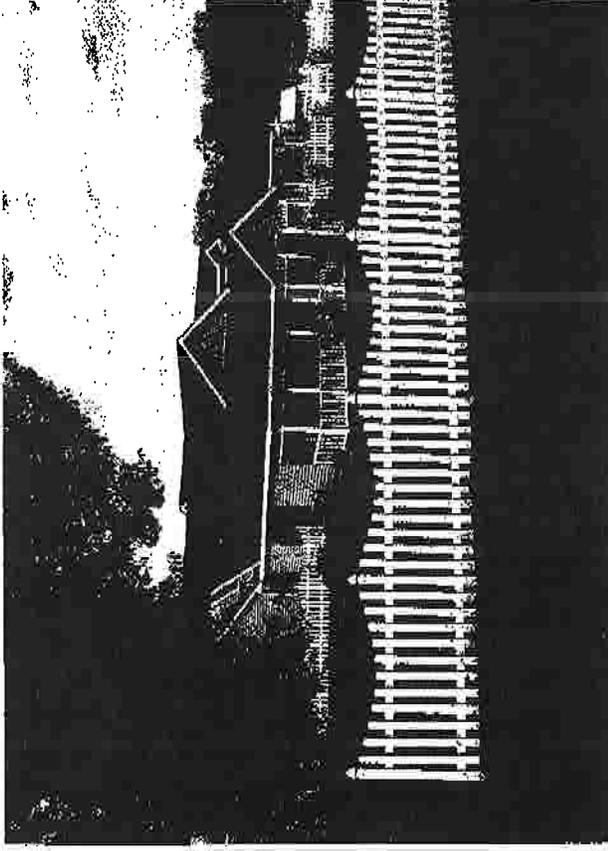


Photo showing plumbing from now disconnected illegal connection between well water and city water. This is how the restaurant switched from city water to well water.

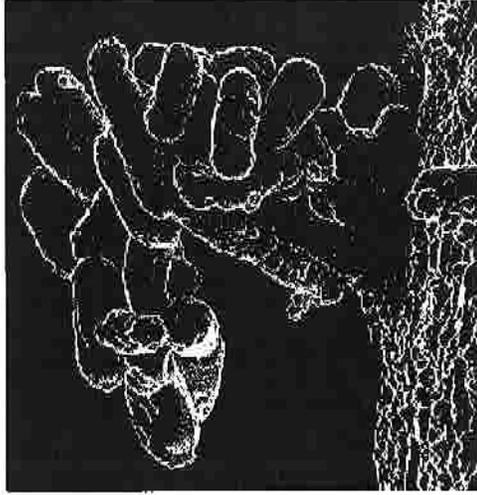
Timeline of Outbreak

- **Aug. 22**
 - OSDH notes "suspicious cluster of illnesses" around Tulsa area.
- **Aug. 23**
 - OSDH inspects Country Cottage. Cited for nine violations. Restaurant throws away all food and reopens.
- **Aug. 24**
 - Chad Ingle of Pryor dies. Ingle ate at CC on Aug. 17.
- **Aug. 25**
 - Restaurant voluntarily closes.



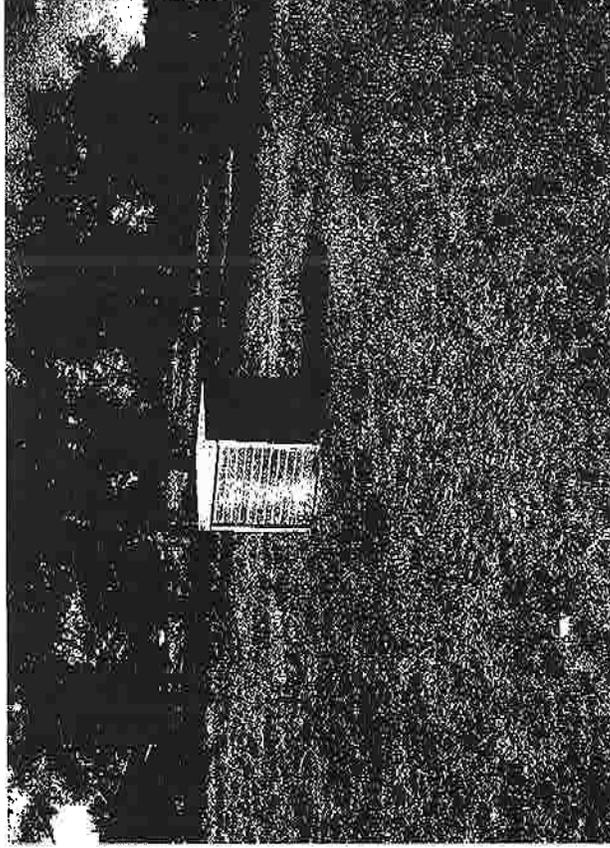
Timeline of Outbreak

- **Aug. 25**
 - OSDH confirms one dead and 14 ill in possible *E. coli* outbreak; confirms Country Cottage as possible source.
 - DEQ first learns of outbreak through press accounts and goes to inspect water supply. DEQ takes water samples from well.



Timeline of Outbreak

- **Aug. 28**
 - DEQ completes analysis of water samples from well at Country Cottage.
 - Water samples contain *E. coli*.
 - DEQ sends cultures to OSDH.
- **Aug. 29**
 - DEQ issues press release stating that *E. coli* was found in Country Cottage Well.
- **Aug. 30**
 - OSDH informs press that results from well do not show virulent strains of *E. coli*. Press reports that the well is not a possible source.



View of Country Cottage well house (behind restaurant) looking west.

Timeline of Outbreak

- **Sept. 12**
 - OSDH investigates restaurant again and finds no trace of *E. coli*.
 - Blood from C.C. food handlers reveal no trace of *E. coli* anti-bodies.

- **Sept. 16**
 - OSDH states that the outbreak is over; investigation continues.



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Effects of Outbreak

- Total known cases: 314
- In-patient hospitalizations: 72
- Patients who required dialysis for renal failure: 17
- Deaths: One
- People interviewed: 1,843
- Victims who ate food provided by Country Cottage in Locust Grove: Every known case
- State and county health workers involved in response and/or inquiry: At least 135

(Source: Oklahoman, Oct. 19, "Examining an Outbreak")

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Braylee Beaver, 20 months old, sickened by E. coli O111 after eating at Country Cottage

(Source: USA Today, Oct. 8, "Little-known E. coli strain O111 starts gaining notoriety")

Country Cottage Well

□ The well is a possible source of the *E. coli* that caused the outbreak of illnesses.



Rick Austin, DEQ, collects water samples on Nov. 5 from the Country Cottage well at the request of the Centers for Disease Control. CDC told DEQ that they are looking for *E. coli* O111 in the well water.

- *E. coli* was not found in the restaurant.
- *E. coli* was found in the well.
- Country Cottage used the well in food preparation on or about Aug. 9-10.
- OSDH agrees that the well is a possible source.
- CDC requested water samples from the well on Nov. 4th and stated that finding *E. coli* in the well "is an interesting finding and supports the possibility that the well could have introduced fecally contaminated water into the restaurant."

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Well Contamination Results

Sample	Agency	Total Coliforms	Escol Coliforms	Fecal Coliforms	Escol Coliforms	Coliforms
Aug. 27	DEQ	> 200	> 200	NT	NT	"suspect colonies found"
Aug. 29	DEQ	> 240	34	NT	NT	"suspect colonies found"
Sept. 4 (LG1)	OAG	240	20	20	18	NT
Oct. 8 (LG1)	OAG	14	2	14	ND	NT

NT - not tested, ND - not detected, Results in MPN/100mL

Bacterial Contamination Not Limited to Country Cottage Well



Bacteria in Local Groundwater

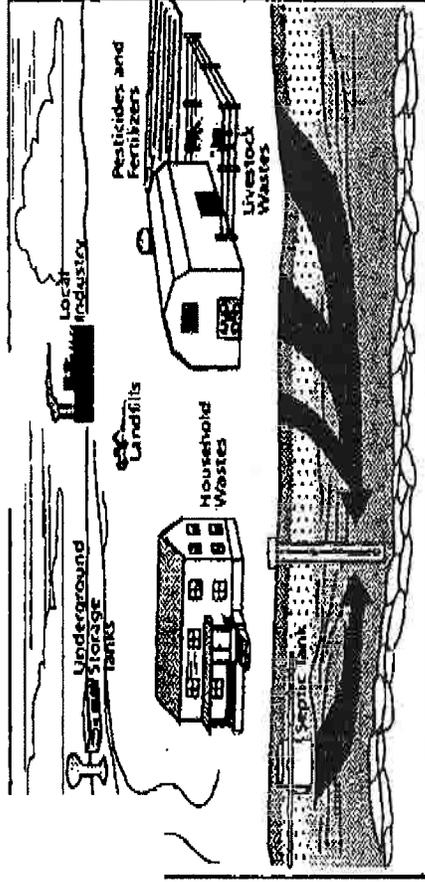
Location	Date	Agency	Total Coliforms	Fecal Coliforms	Fecal Streptococci	Fecal Coliforms
Moore's Residence (LG7)	Sept. 24	DEQ	613	4	NT	NT
Football Field (LG8)	Sept. 24	DEQ	214	ND	NT	NT
Newcomb Well (LG6)	Oct. 8	OAG	50	30	4	50
Haddock Well (LG4)	Oct. 8	OAG	ND	ND	NT	4
Football Field (LG8)	Nov. 7	OAG	46	ND	8	46

NT - not tested, ND - not detected, Results in MPN/100mL

Possible Sources of Bacterial Groundwater Contamination

□ There are only two possible sources of *E. coli*, which is produced in the intestines of warm-blooded animals:

- *Human Waste*
- *Animal Waste*

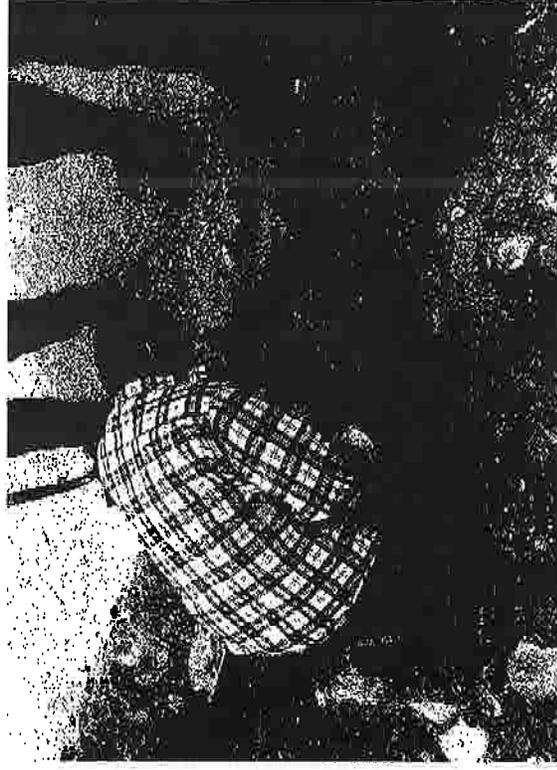


Human Waste Contribution

- DEQ has investigated potential human waste contribution to Country Cottage well contamination.
- Two possible sources: septic and sewer.



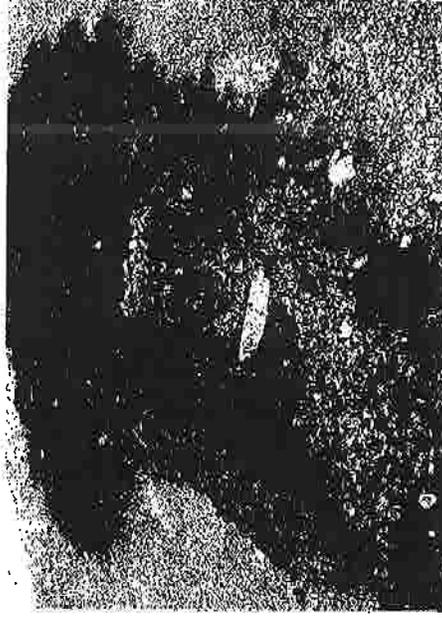
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Photos from DEQ investigation on Nov. 5, 2008 14

Human Waste Contribution - Septic

- Abandoned septic system at Country Cottage located, lateral lines investigated. DEQ and Dr. Bert Fisher observe as follows: "dry hole, dry line, no biomass discoloration."
- Septic tank next door to Country Cottage inspected. Out of service for many years.
- **Conclusion:** Abandoned septic systems in the immediate vicinity of the Country Cottage well have been out of use for years and are not contributing any human waste to the groundwater.



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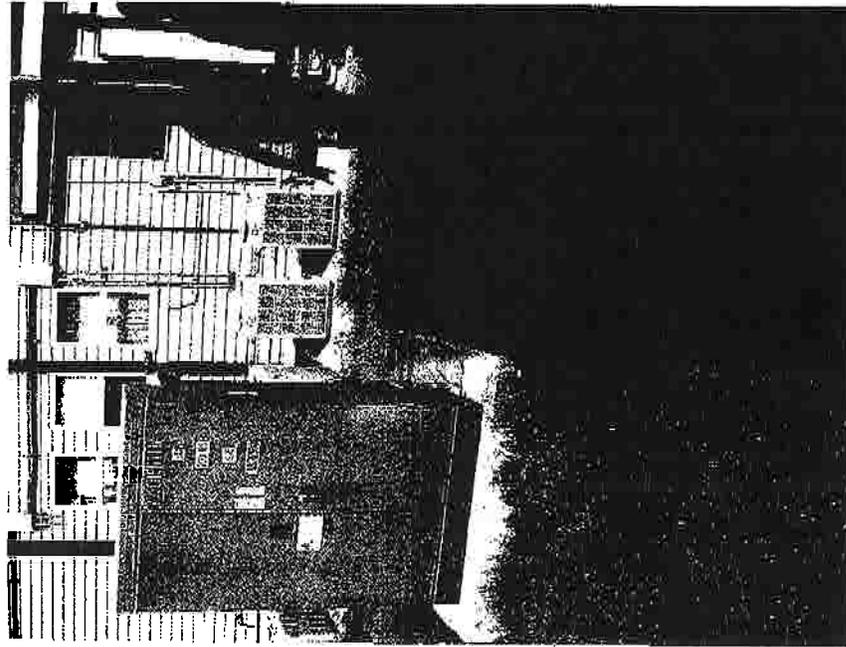
Photos from DEQ investigation on Nov. 5, 2008

Human Waste Contribution - Sewer

- Nov. 5 - DEQ inspected the sewer connection to the Country Cottage with a dye test.
- Nov. 20 & Dec. 4 - DEQ inspected the sewer connection with a smoke test.
- **Conclusion:** Human waste from the sewer is not contaminating groundwater in the vicinity of the Country Cottage.



Conclusion: Human Waste Contribution



Dr. Bert Fisher and Rick Austin, DEQ, investigate possible human waste contribution.

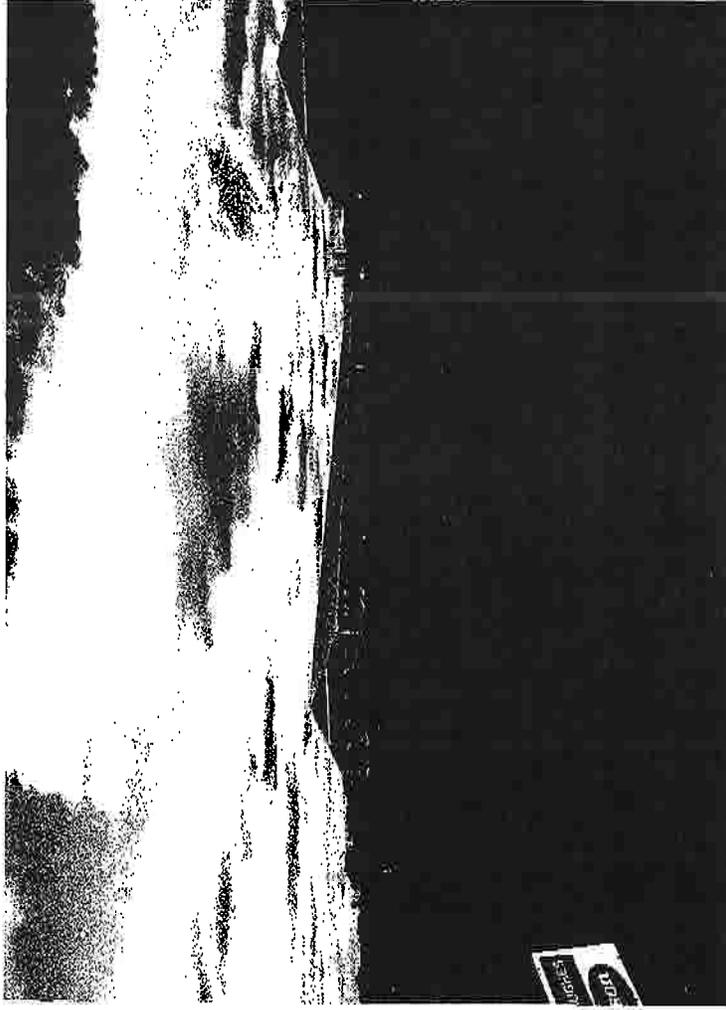
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Conclusions of Dr. Fisher:

- **Animal Source:** It is highly unlikely that the bacteria contamination in the Country Cottage well resulted from human waste. It is very likely, therefore, that this contamination resulted from animal waste.
- There is no proximate source of human waste that could have contaminated the well.
- **Common Source:** The large area of bacteria contamination suggests a large source, and a common source.
- The decrease in the concentrations of bacteria over time (August through November) suggest one or more upgradient events in the spring or summer as the cause of the bacteria contamination.

Animal Waste Contribution

- Two animal populations in the vicinity: cattle and poultry.
- Cattle populations are relatively small and dispersed. There are no concentrated cattle feeding lots or dairies in a ten mile radius.
- Poultry operations are large and concentrated.



Tyson poultry houses, 2.7 miles up gradient of Country Cottage - Terri Hughes, Grower for Tyson

Animal Waste Contribution - Poultry



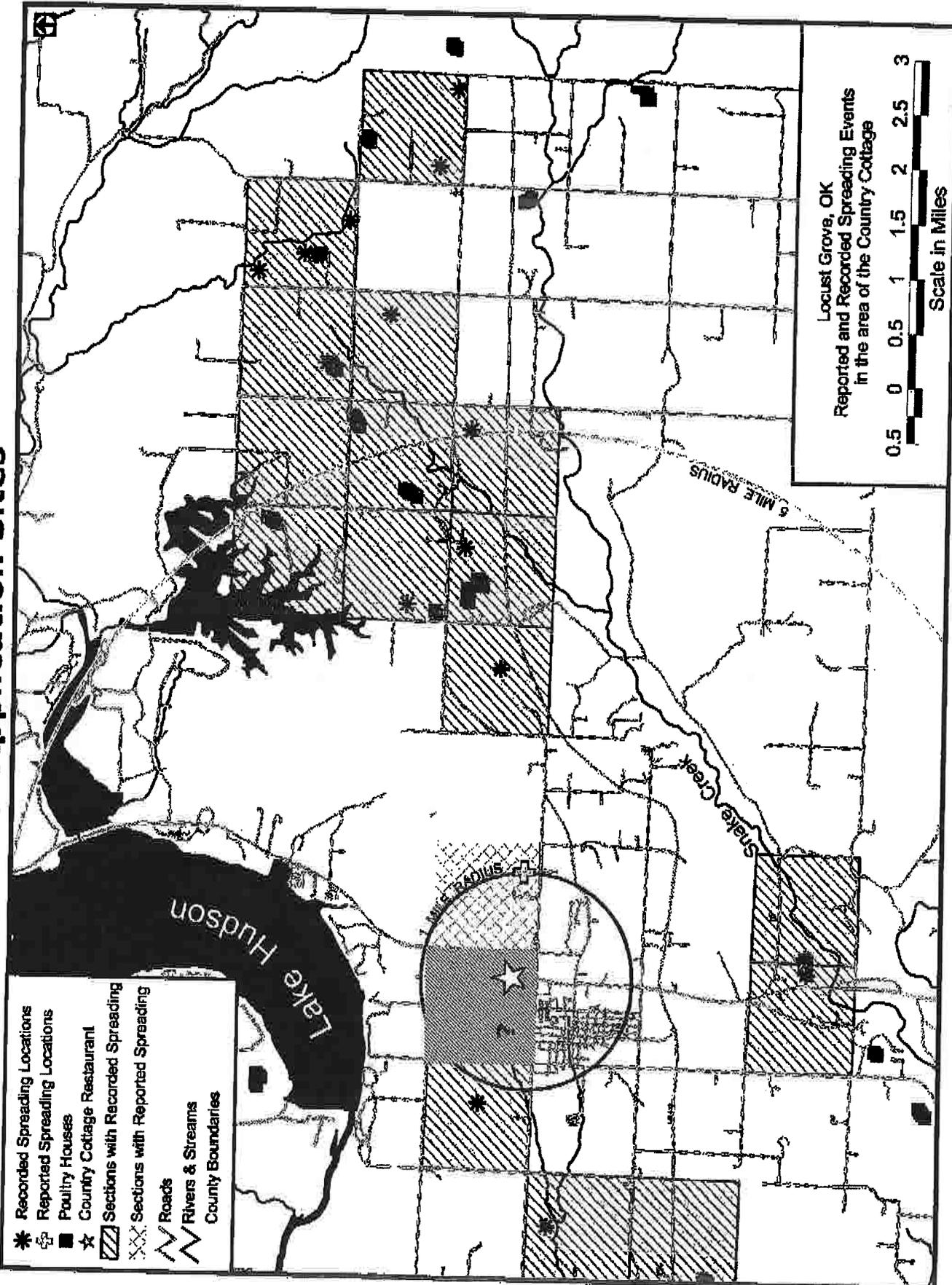
Examples of nearby active chicken houses (within 5 miles, NAIP aerial photos, 2008)

- Five-Mile Radius:
 - **39** active poultry houses.
 - **4 to 6 million** birds produced a year.
 - **5,000 to 7,000** tons of poultry waste generated each year.

- Within 10 miles of Country Cottage well:
 - **113** active houses within 10 miles.

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Poultry Houses and Litter Application Sites



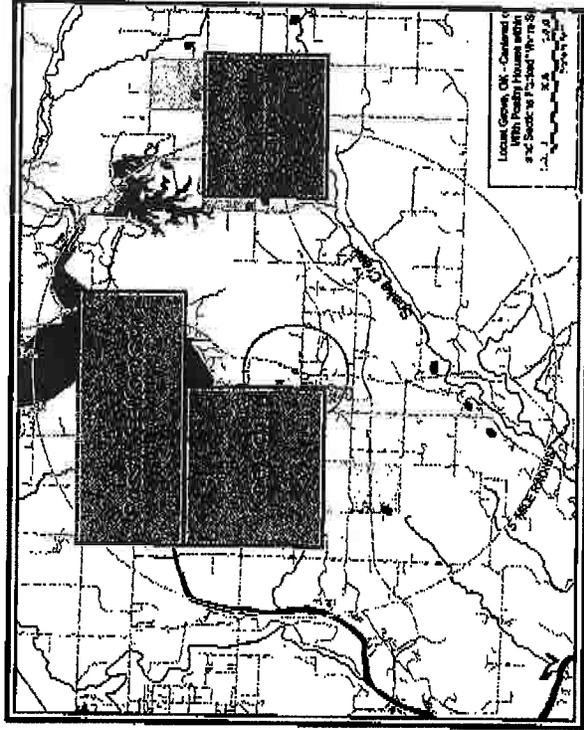
- * Recorded Spreading Locations
- ☒ Reported Spreading Locations
- Poultry Houses
- ☆ Country Cottage Restaurant
- ▨ Sections with Recorded Spreading
- ▩ Sections with Reported Spreading
- Roads
- ~ Rivers & Streams
- County Boundaries

Locust Grove, OK
 Reported and Recorded Spreading Events
 in the area of the Country Cottage

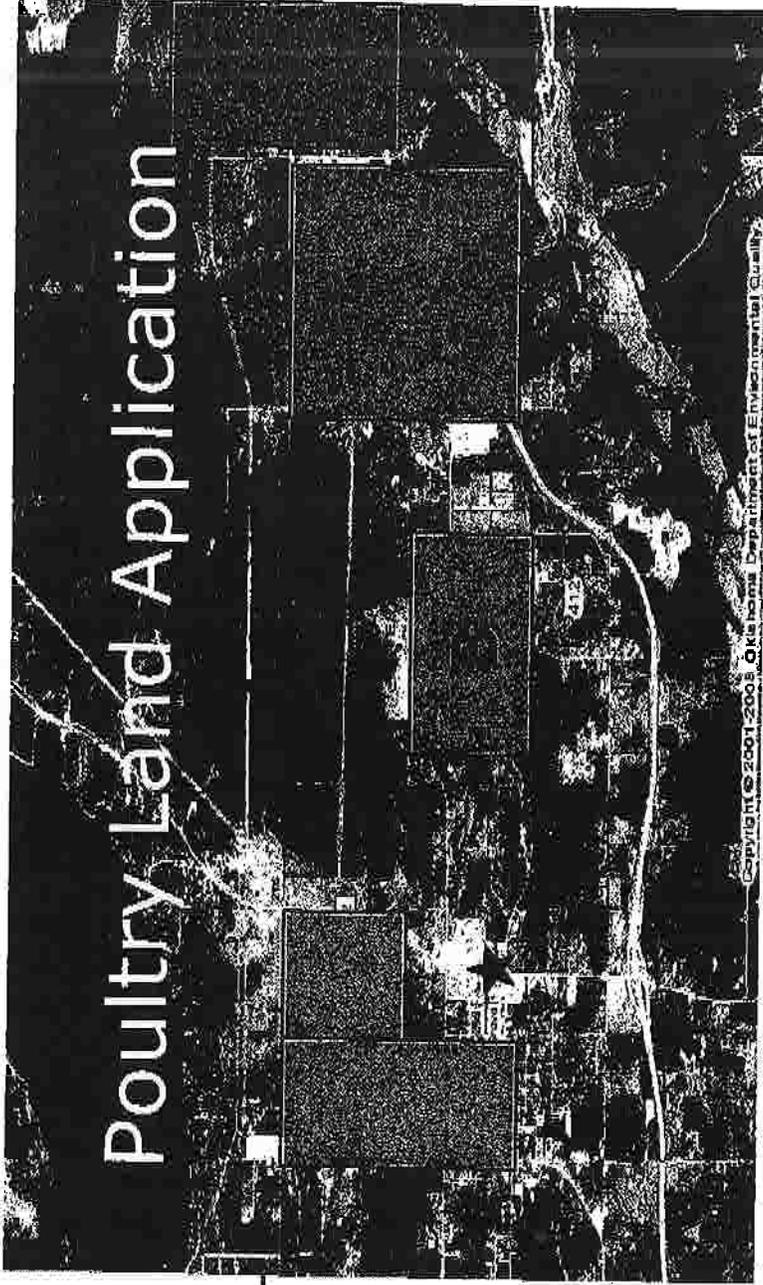


Animal Waste Contribution - Poultry

- Land application is documented near Hughes Tyson operation (2.7 miles) and on Perkins property (less than 2 miles) (ODAFF records).
- Possible land application within ¼ mile of Country Cottage at Eugene Koelsch property.



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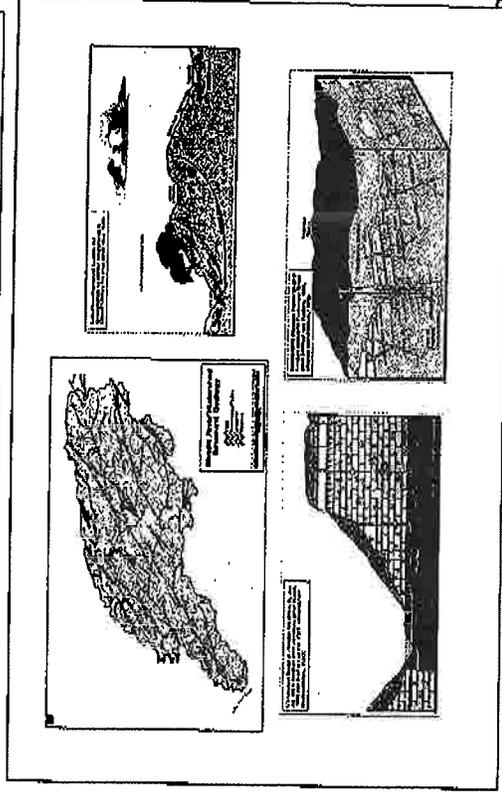
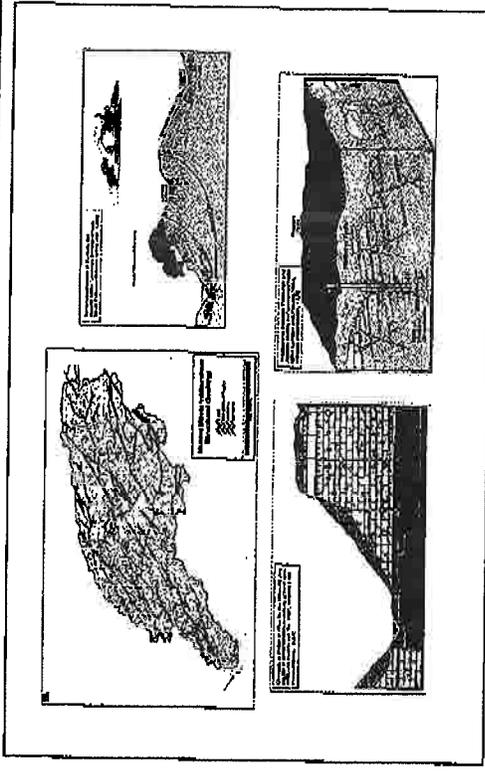


- Land application documented on Area "A" – Eugene Koelsch property. Approximately ¼ mile from well. Location undetermined because Koelsch family owns property all around restaurant.
- Conflicting reports concerning land application on Connor property.
- Visual inspection by Dr. Bert Fisher confirms that Areas "A" "B" "C" & "D" all appear to be fields typically applied with poultry litter. (Monospecific, hay production, etc.) Confirmed by visual observation and historic aerial photos.
- Records from Perkins (applicator) confirm frequent and reoccurring land application on Area "C."
- ODAFF documents Area "D" is a confirmed land application area (Hughes and Cole).

Animal Waste Contribution - Poultry

□ According to Dr. Bert Fisher, the vicinity of Country Cottage restaurant is a mantled karst terrain, allowing for the easy transport of contaminants from the land to the groundwater.

□ Dr. Fisher believes that a contaminant pathway exists connecting the land-applied fields to the Country Cottage well.

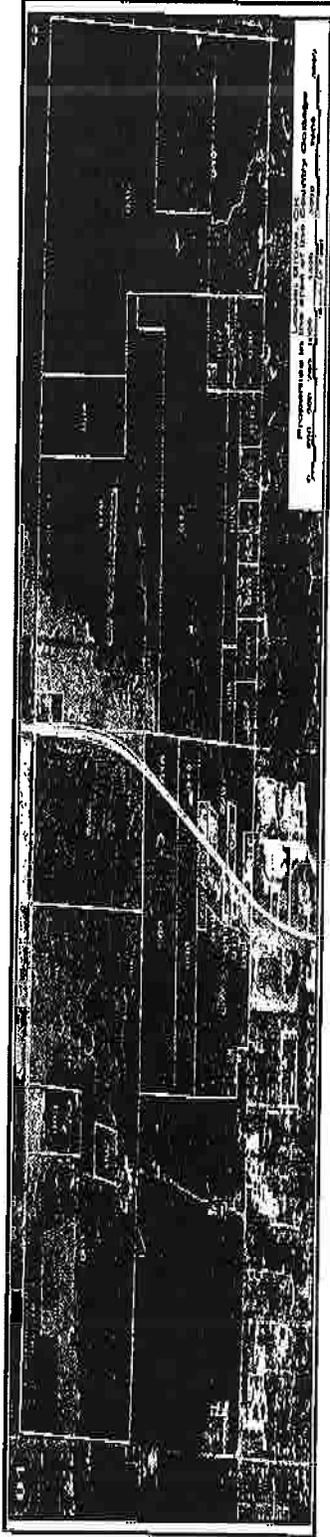


Animal Waste Contribution - PCA

- Dr. Roger Olsen performed a Principal Component Analysis (PCA) on water samples from several sites around and including the Country Cottage restaurant.
- The PCA analysis revealed a unique "chicken signature" at more than one location, including the well at the Country Cottage restaurant.
- Cattle signature and human waste signature "not present."

Country Cottage
Well "strong
chicken signature"
Two Samples

Newcomb well
"strong chicken
signature"



Football Field
"weak chicken
signature"

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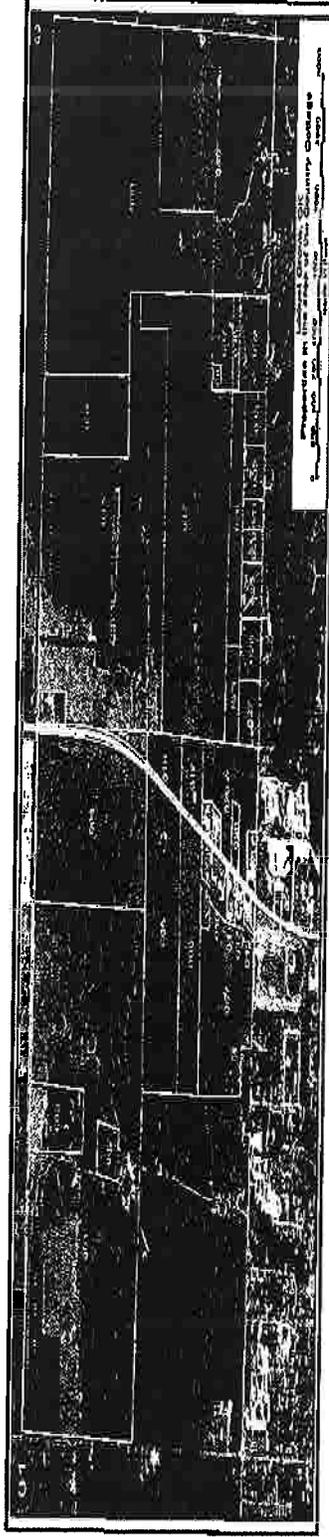
Animal Waste Contribution - PCR

- Northwind Laboratory (in consultation with Dr. Jody Harwood) conducted a DNA analysis of water samples from several wells (qPCR).
- Results show the presence of poultry-specific biomarker (*brevibacteria*) in several wells, including the country cottage.

Haddock Well
biomarker
PRESENT

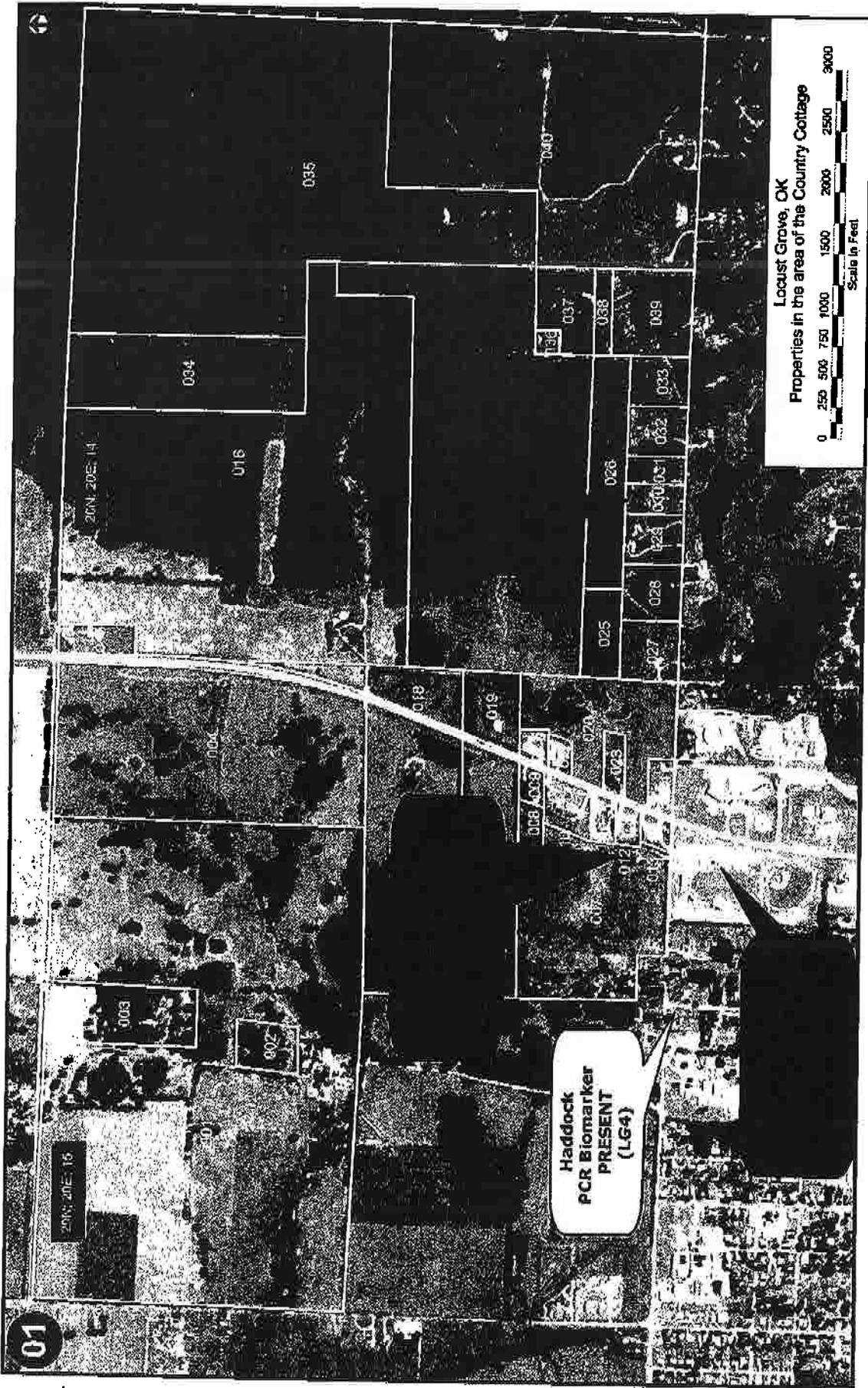
Country Cottage Well
biomarker
PRESENT

Football Field Well
Biomarker
PRESENT



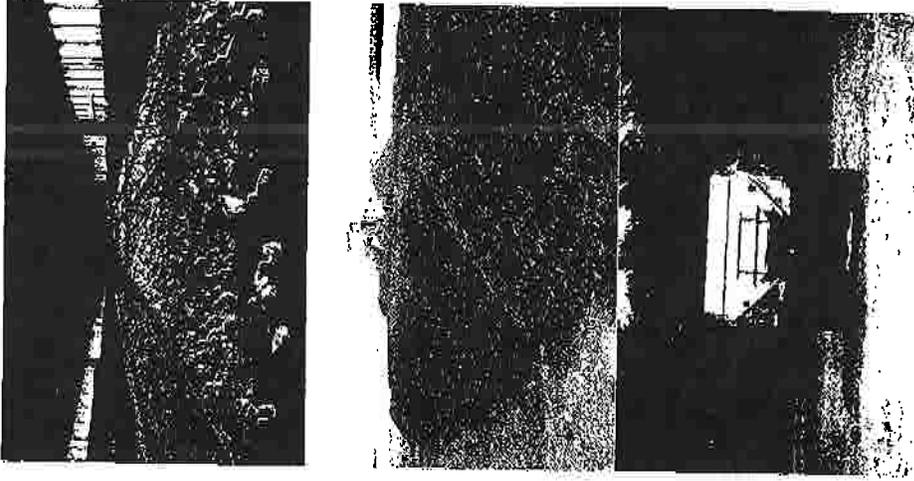
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Summary of PCA and PCR Results



Summary

- The Country Cottage well is a possible source of the *E. coli* that caused the outbreak of illnesses.
- It is very unlikely that human waste contributed the *E. coli* in the Country Cottage well.
- A large "plume" of bacterial contamination in the groundwater is suggestive of a large source.
- Although cattle are present in the vicinity of the well, they are not confined or concentrated in large numbers.
- A significant poultry population is raised within a 5-mile radius.
- Poultry waste is land applied within the vicinity of the Country Cottage.
- The mantled karst terrain with a gradient from the pastures to the Country Cottage provides a pathway for bacterial transport.
- PCA results indicate that the "chicken signature" is present in the Country Cottage well, and other wells in the vicinity.
- PCR results prove existence of poultry-specific biomarker in groundwater of Country Cottage well, and other wells in the vicinity.



Conclusion

- The likely source of the bacteria in the Country Cottage well is poultry waste.
- This poultry waste is a possible cause of the *E. coli* outbreak.
- The specific strain of *E. coli* that has caused illness and death, "O111", has been found in poultry waste.

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